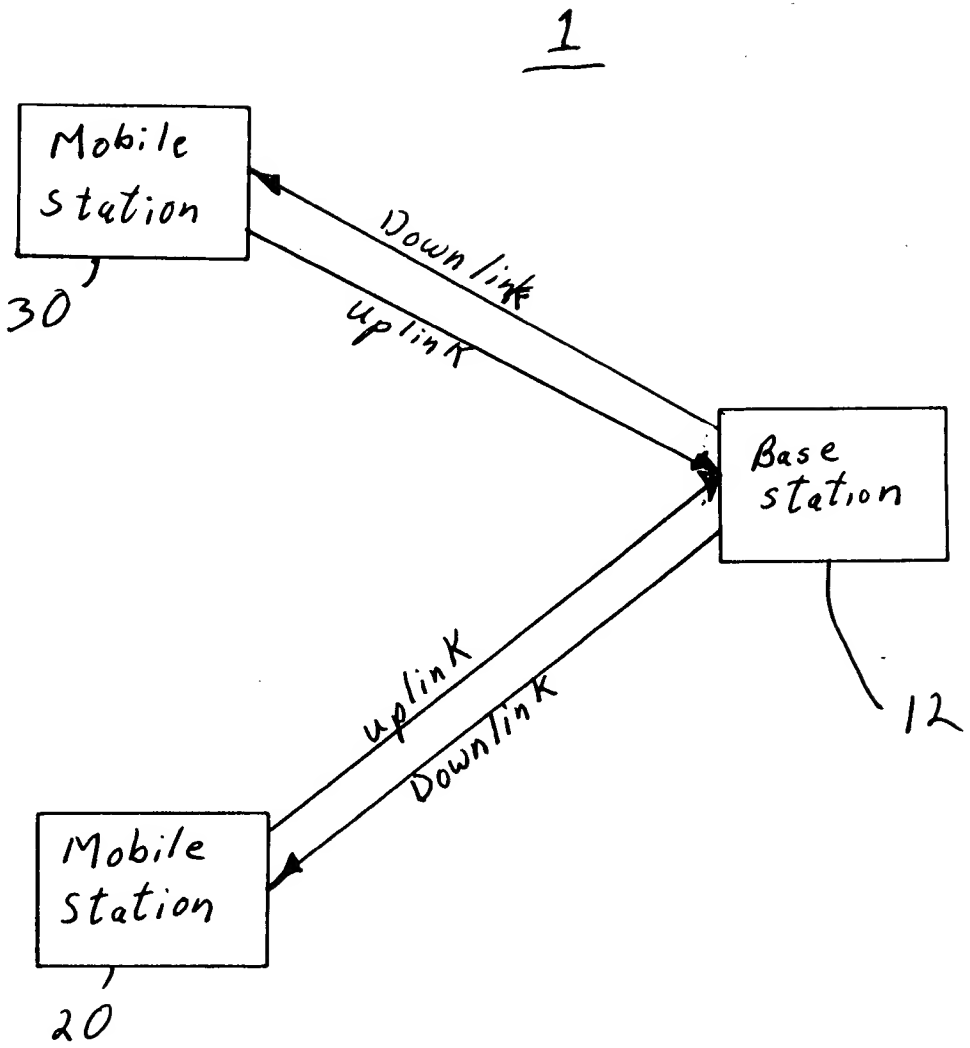
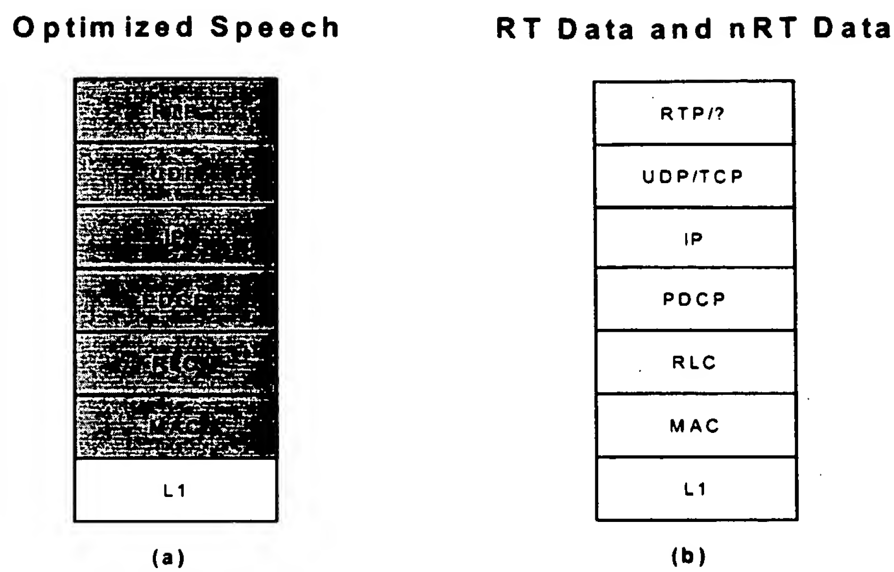
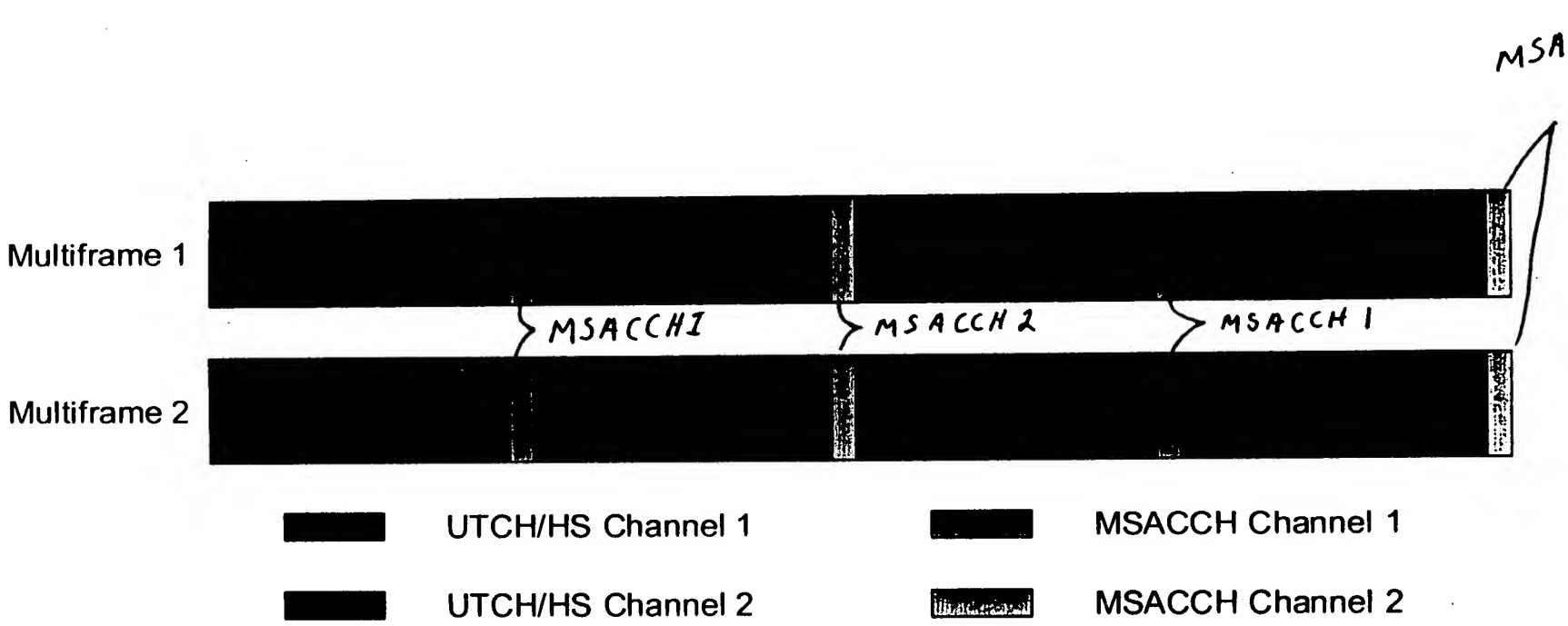


FIG. 1



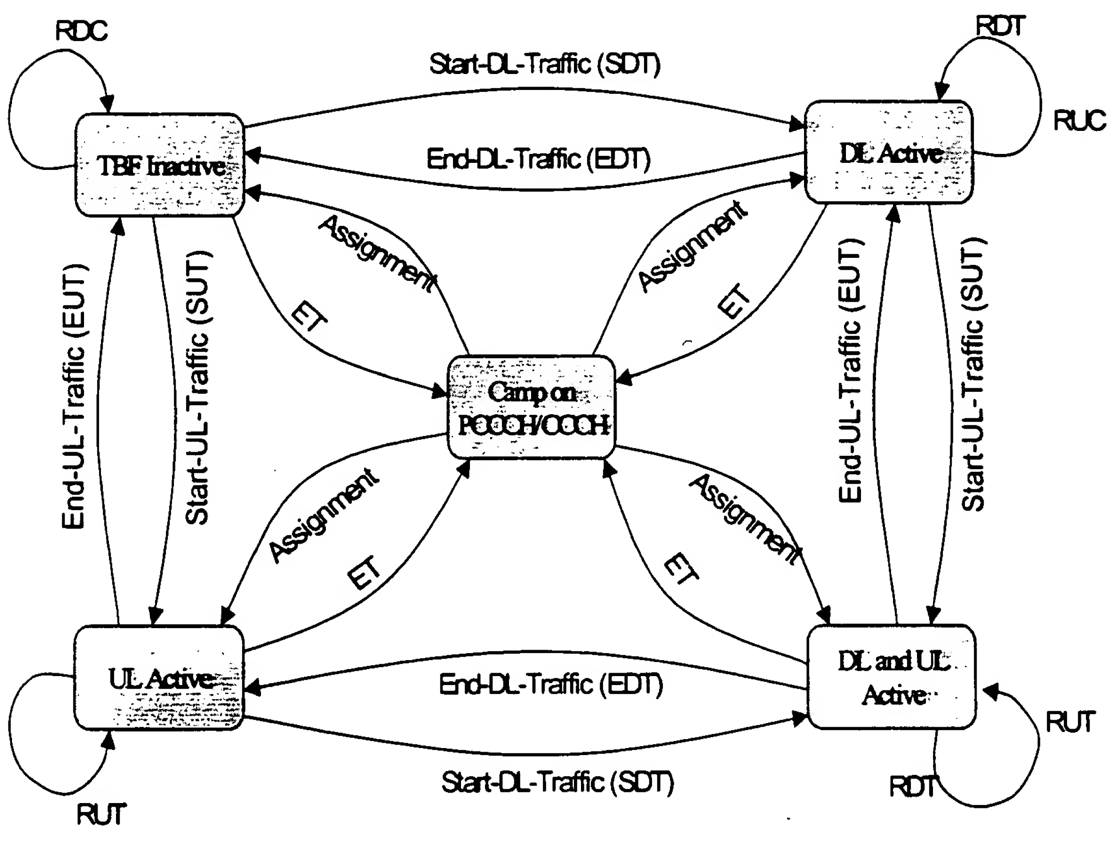
Note:; Shaded Parts are eliminated from the overhead of speech frames

FIG. 2



For data traffic channels, there is no MSACCH, and all allocated bursts in the time slot are available for traffic.

FIG. 3



ET: End-TBF

RDT: Reassign-DL-Traffic
RUT: Reassign-UL-Traffic

RDC: Reassign-DL-Control
RUC: Reassign-UL-Control

FIG. 4

RT TBF State	Traffic Activity		TCH Channel Assignment		Control Channel Assignment	
	UL	DL	UL	DL	UL	DL
TBF Inactive	idle	idle			FRACH FACKCH UPRCH UBMCH	FASSCH DPRCH DBMCH
UL Active	active	idle	UTCH/ (B)FACCH / MSACCH		FRACH FACKCH UBMCH	FASSCH DPRCH DBMCH
DL Active	idle	active		DTCH/ (B)FACCH / MSACCH	FRACH FACKCH UPRCH UBMCH	FASSCH DBMCH
UL + DL Active	active	active	UTCH/ (B)FACCH / MSACCH	DTCH/ (B)FACCH / MSACCH	FRACH FACKCH UBMCH	FASSCH DBMCH

FIG. 5

Procedures	RT TBF State			
	Inactive	UL Active	DL Active	DL+UL Active
Reassign DL Control (RDC)	x	x		
Reassign UL Control (RUC)	x		x	
Start DL Traffic (SDT)	x	x		
End DL Traffic (EDT)			x	x
Reassign DL Traffic (RDT)			x	x
Start UL Traffic (SUT)	x		x	
End UL Traffic (EUT)		x		x
Reassign UL Traffic (RUT)		x		x
End TBF (ET)	x	x	x	x
Start new TBF (ST)	x	x	x	x

FIG. 6

Message	Channel During Uplink Traffic	Channel with no Uplink Traffic
Access Request	BFACCH	FRACH
Acknowledge to Assignment	BFACCH	FACKCH
AMR Mode Request	UTCH	UPRCH
SID Update	N/A	UPRCH
Neighbor Measurement Report	MSACCH	UPRCH
RLC Signaling	UTCH	UBMCH
End TBF Request	BFACCH	FRACH

FIG. 7

Message	Channel During DL Traffic	Channel with no DL Traffic
Assignment (all)	BFACCH	FASSCH
AMR Mode Command	DTCH	DPRCH
SID Update	N/A	DPRCH
Handover Directives	FACCH	DBMCH
RLC Signaling	DTCH	DBMCH
Timing Advance	MSACCH	DPRCH
Power Control	MSACCH	DPRCH
End TBF Command	BFACCH	FASSCH

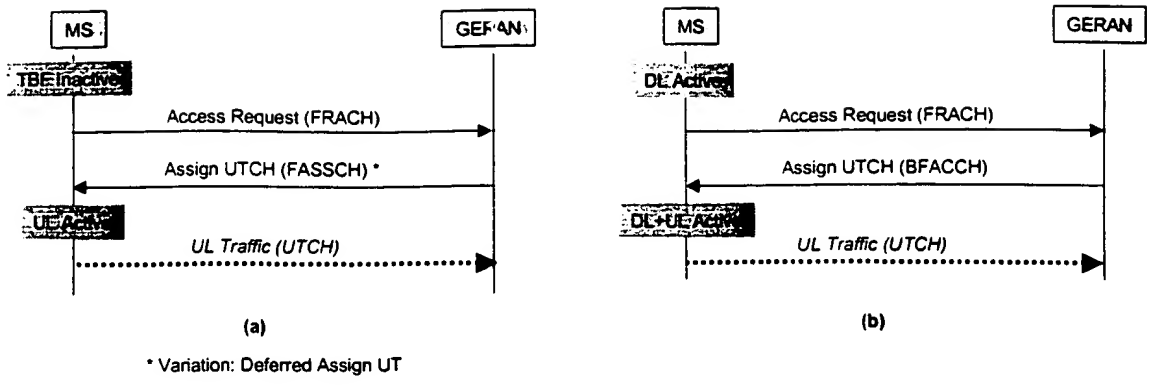
FIG. 8

Downlink Burst Message	Information Elements
Assign UTCH	ARI, DMT, TBFI, CID, CTS, PH, SD
Deferred Assign UTCH	ARI, DMT, TBFI, RRBP, delay
Assign DTCH	ARI, DMT, TBFI, RRBP, CID, CTS, PH, SD
Assign UPRCH	ARI, DMT, RRBP, CID, CTS, OFF
Assign DPRCH	ARI, DMT, RRBP, CID, CTS, OFF
Assign FRACH	ARI, DMT, RRBP, CID, CTS, PH
Assign FACKCH	ARI, DMT, RRBP, CID, CTS, PH
Assign FASSCH	ARI, DMT, RRBP, CID, CTS, PH
End TBF Command	ARI, DMT, TBFI, RRBP, reason

FIG. 9

Uplink Burst Message	Information Elements
Access Request	ARI, UMT, TBFI
Acknowledge UTCH	ARI, UMT, TBFI
Acknowledge DTCH	ARI, UMT, TBFI
Acknowledge UPRCH	ARI, UMT, TBFI
Acknowledge DPRCH	ARI, UMT, TBFI
Acknowledge FRACH	ARI, UMT, TBFI
Acknowledge FACKCH	ARI, UMT, TBFI
Acknowledge FASSCH	ARI, UMT, TBFI
Acknowledge End TBF	ARI, UMT, TBFI
End TBF Request	ARI, UMT, TBFI, reason

FIG. 10



* Variation: Deferred Assign UT

FIG 11

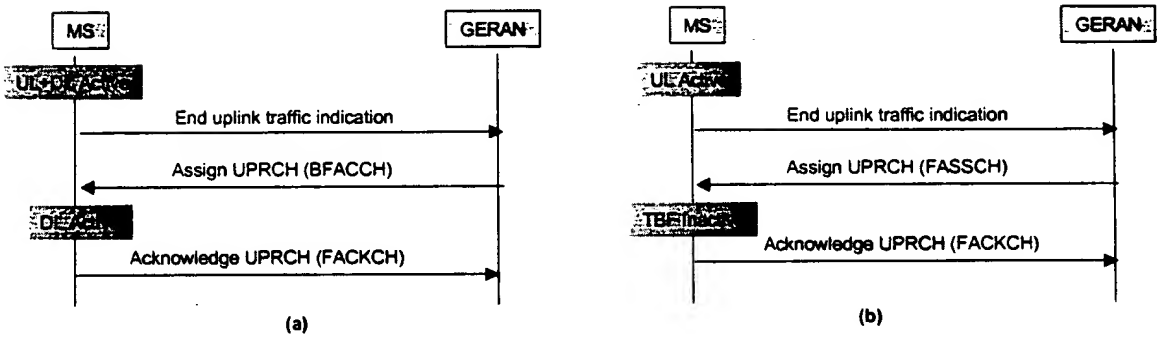


FIG 12

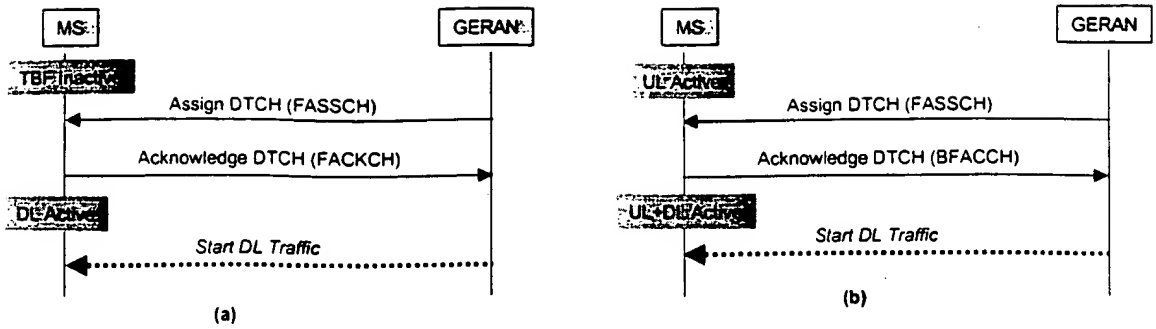

MS
GERAN
TBF Inactive
Assign DTCH (FASSCH)
Acknowledge DTCH (FACKCH)
DL Active
Start DL Traffic
(a)
MS
GERAN
UL Active
Assign DTCH (FASSCH)
Acknowledge DTCH (BFACCH)
UL+DL Active
Start DL Traffic
(b)

FIG. 13

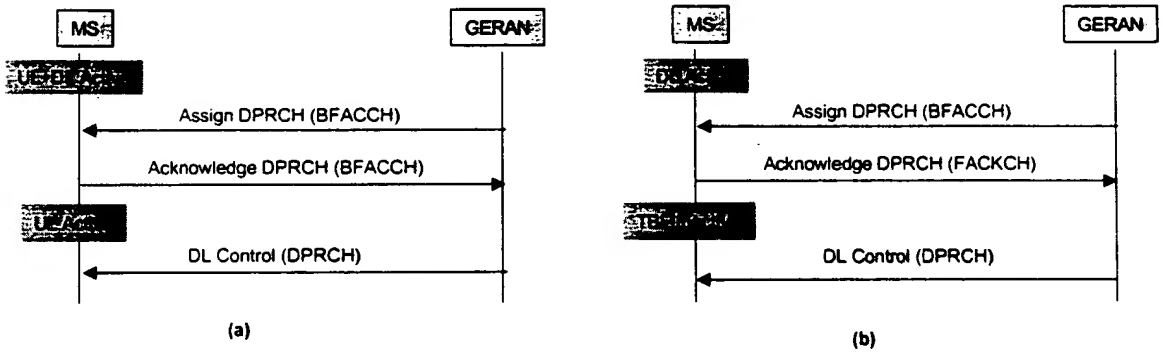

MS
GERAN
Assign DPRCH (BFACCH)
Acknowledge DPRCH (BFACCH)
DL Control (DPRCH)
(a)
MS
GERAN
Assign DPRCH (BFACCH)
Acknowledge DPRCH (FACKCH)
DL Control (DPRCH)
(b)

FIG. 14

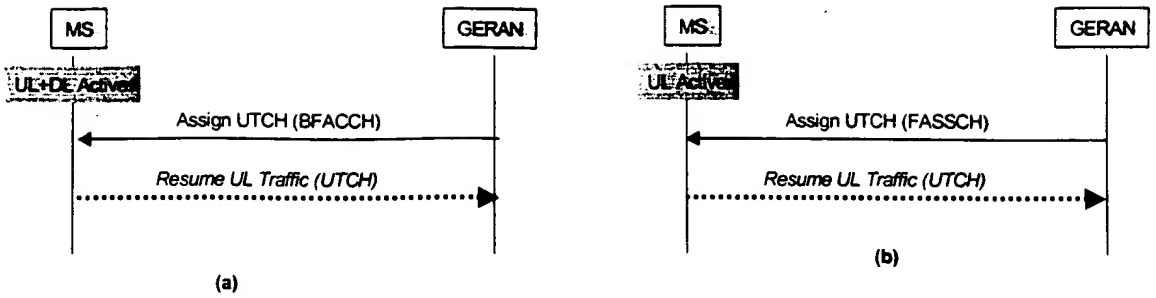

MS
GERAN
UL+DL Active
Assign UTCH (BFACCH)
Resume UL Traffic (UTCH)
(a)
MS
GERAN
UL Active
Assign UTCH (FASSCH)
Resume UL Traffic (UTCH)
(b)

FIG. 15

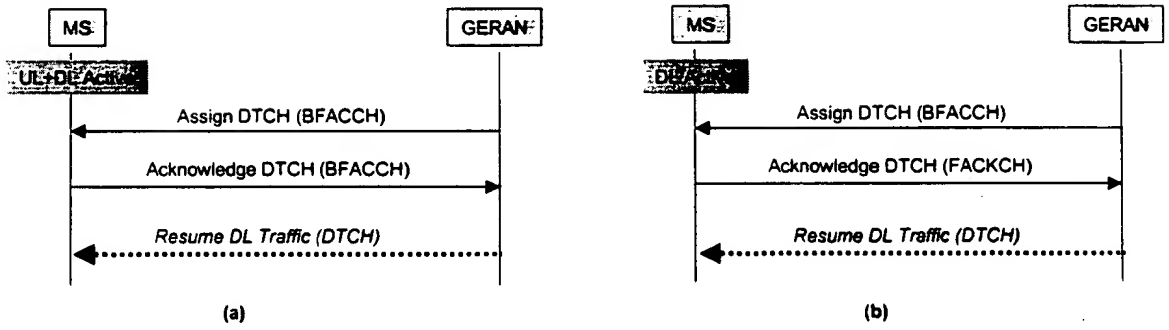

MS
GERAN
UL+DL Active
Assign DTCH (BFACCH)
Acknowledge DTCH (BFACCH)
Resume DL Traffic (DTCH)
(a)
MS
GERAN
DL Active
Assign DTCH (BFACCH)
Acknowledge DTCH (FACKCH)
Resume DL Traffic (DTCH)
(b)

FIG. 16

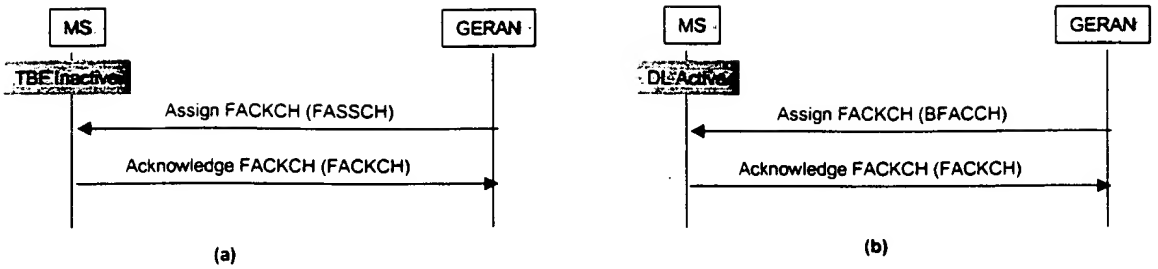

MS
GERAN
TBF Inactive
Assign FACKCH (FASSCH)
Acknowledge FACKCH (FACKCH)
(a)
MS
GERAN
DL Active
Assign FACKCH (BFACCH)
Acknowledge FACKCH (FACKCH)
(b)

FIG. 17

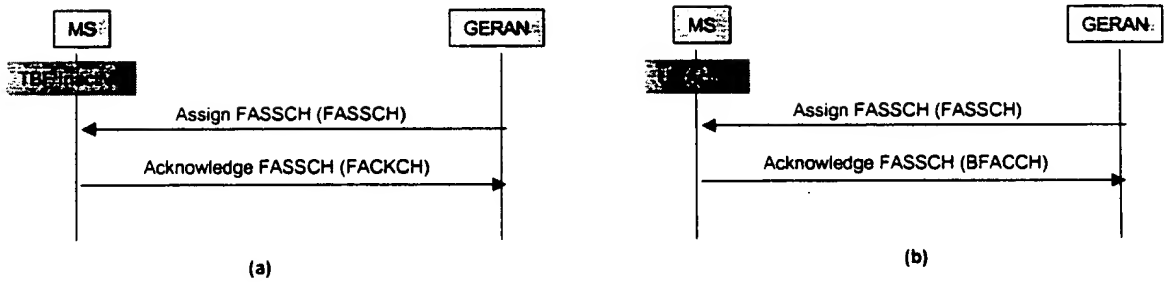
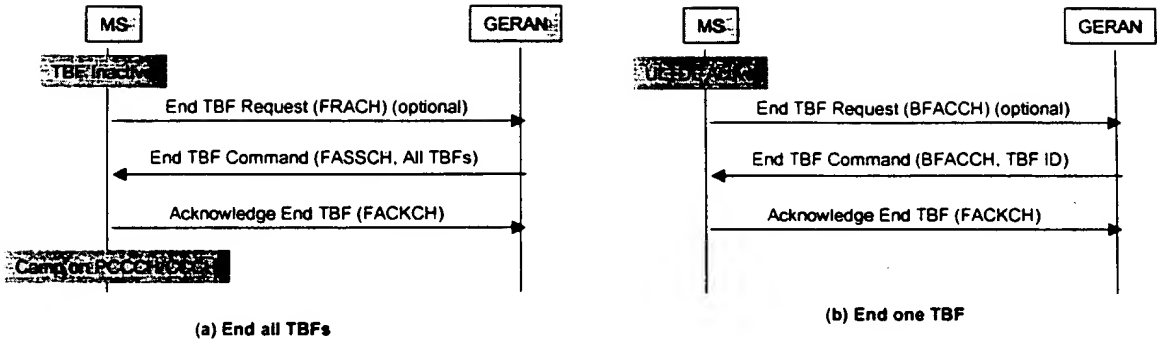

MS
GERAN
Assign FASSCH (FASSCH)
Acknowledge FASSCH (FACKCH)
(a)
MS
GERAN
Assign FASSCH (FASSCH)
Acknowledge FASSCH (BFACCH)
(b)

FIG. 18



(a) End all TBFs

(b) End one TBF

FIG. 19

D(i, even) Downlink time slot i, bursts 0246... D(i, odd) Downlink time slot i, bursts 1357...

Resources to which a downlink talkspurt may be allocated

Overlap with transmissions during odd bursts on uplink time slot 5

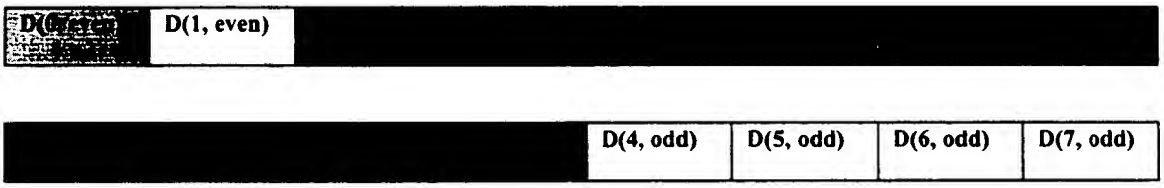
FIG. 20

D(i, 0123) Downlink time slot i, bursts 0123... D(i, 4567) Downlink time slot i, bursts 4567...

Resources to which a downlink talkspurt may be allocated

Transmissions during burst 7 on uplink time slot 5 overlap with burst 0 on downlink time slot 0

FIG. 21

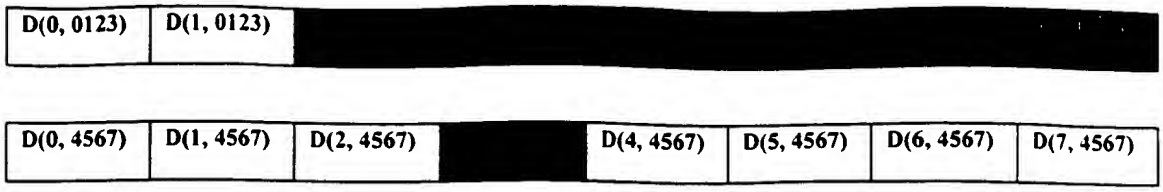


D(i, even) Downlink time slot i, bursts 0246... D(i, odd) Downlink time slot i, bursts 1357

Resources to which a downlink talkspurt may be allocated

Overlap with transmissions during odd bursts on uplink time slot 5

FIG. 22

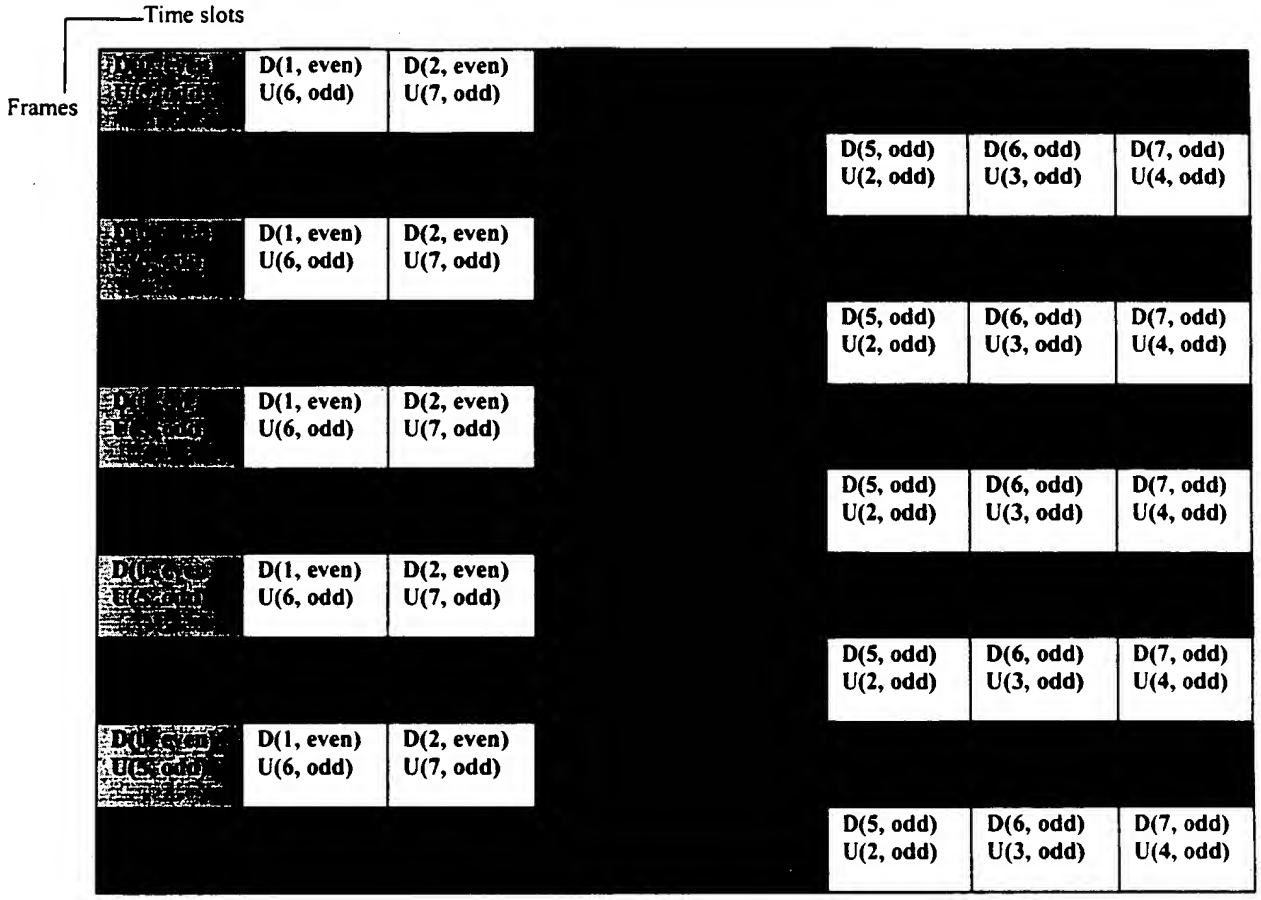


D(i, 0123) Downlink time slot i, bursts 0123... D(i, 4567) Downlink time slot i, bursts 4567...

Resources to which a downlink talkspurt may be allocated

Transmissions during burst 7 on uplink time slot 5 overlap with burst 0 on downlink time slot 0

FIG. 23

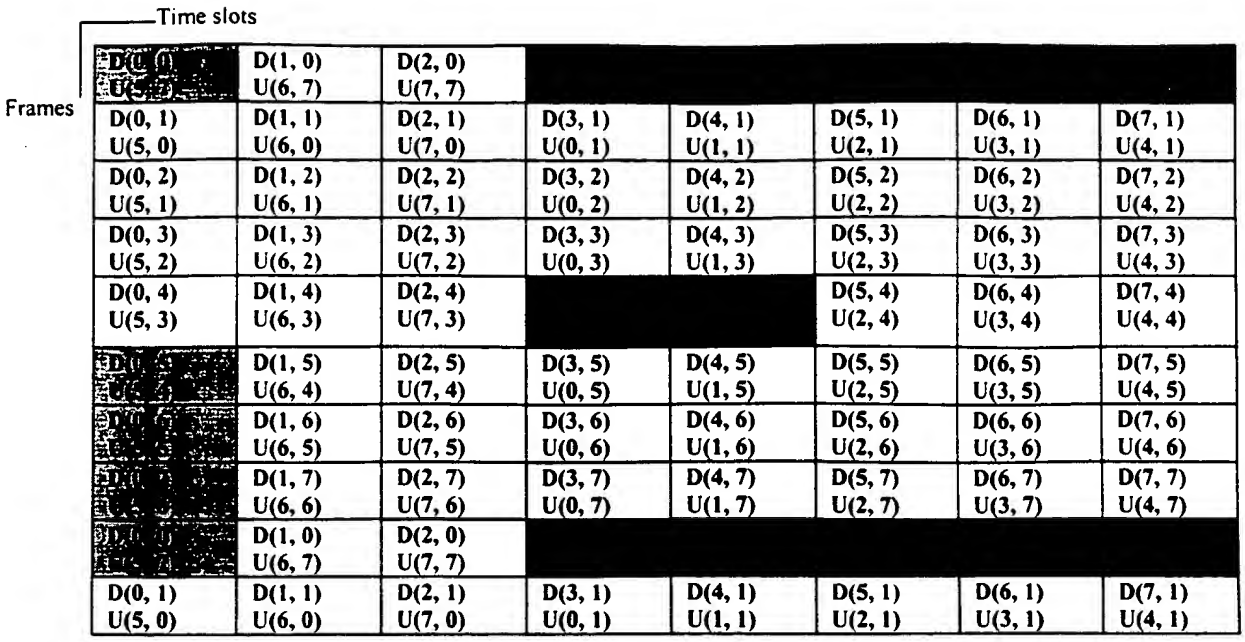


D(i, j) Downlink time slot i, burst j U(i, j) Uplink time slot i, burst j

Bursts during which uplink speech transmission occurs

Bursts on which a downlink talkspurt may start

FIG. 24

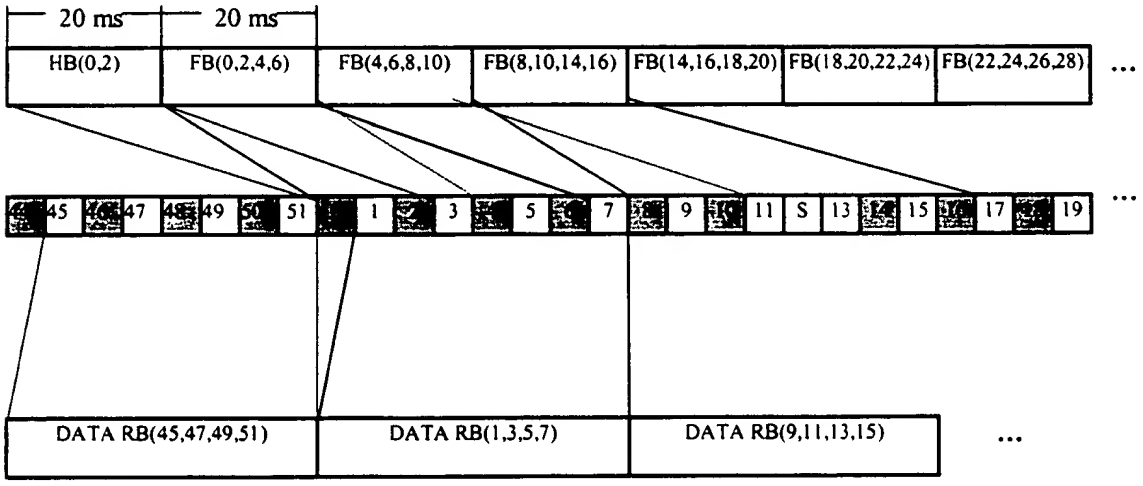


D(i, j) Downlink time slot i, burst j U(i, j) Uplink time slot i, burst j

Bursts during which uplink speech transmission occurs

Bursts on which a downlink talkspurt may start

FIG. 25



HB(i,j) Half Block for speech coded and interleaved over bursts i and j

FB(i,j,k,l) Full Block for speech coded and interleaved over bursts i, j, k and l

S SACCH burst for half rate speech traffic channel

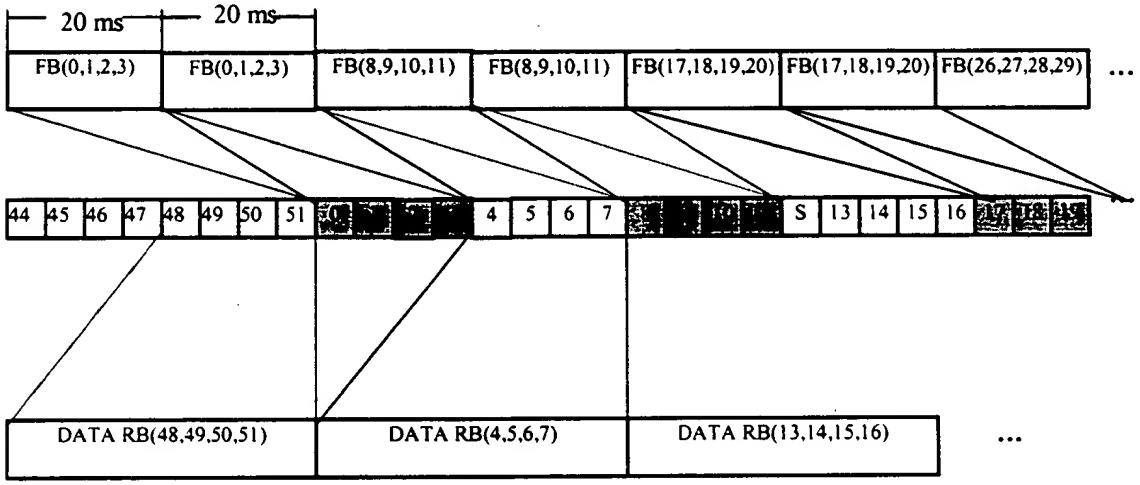
RB Radio Block

FIG. 26

Speech Frame Number	0246/1357 Interleaving		0123/4567 Interleaving	
	Arrival at Receiver (ms)	Play Out (ms)	Arrival at Receiver (ms)	Play Out (ms)
0	9.23	14	13.845	14
1	27.69	34	13.845	34
2	46.15	54	50.765	54
3	73.84	74	50.765	74
4	92.3	94	92.3	94
5	110.76	114	92.3	114
6	129.22	134	133.835	134

Table: Speech frame arrivals and play out instants with different interleaving approaches; the end of burst 0 occurs at 0.0 ms.

FIG. 27



FB(i,j,k,l) Full Block for speech interleaved over bursts i, j, k and l
S SACCH burst for half rate speech traffic channel
RB Radio Block

FIG. 28

Channel	Interleaving	Vocoder Rate	Coding Rate	C/I (dB) for 1% FER	
				iFH	no FH
TU3	0246/1357	7.4 EEP	0.41	13.15	**18.8**
	0123/4567	7.4 EEP	0.41	13.1	19.8
BU100	0246/1357	7.4 EEP	0.41	13.5	**13.1**
	0123/4567	7.4 EEP	0.41	13.3	13.5
HT100	0246/1357	7.4 EEP	0.41	14.7	**15.5**
	0123/4567	7.4 EEP	0.41	14.9	16.3

Table: Performance of the two interleaving schemes with QPSK modulation.

FIG. 29

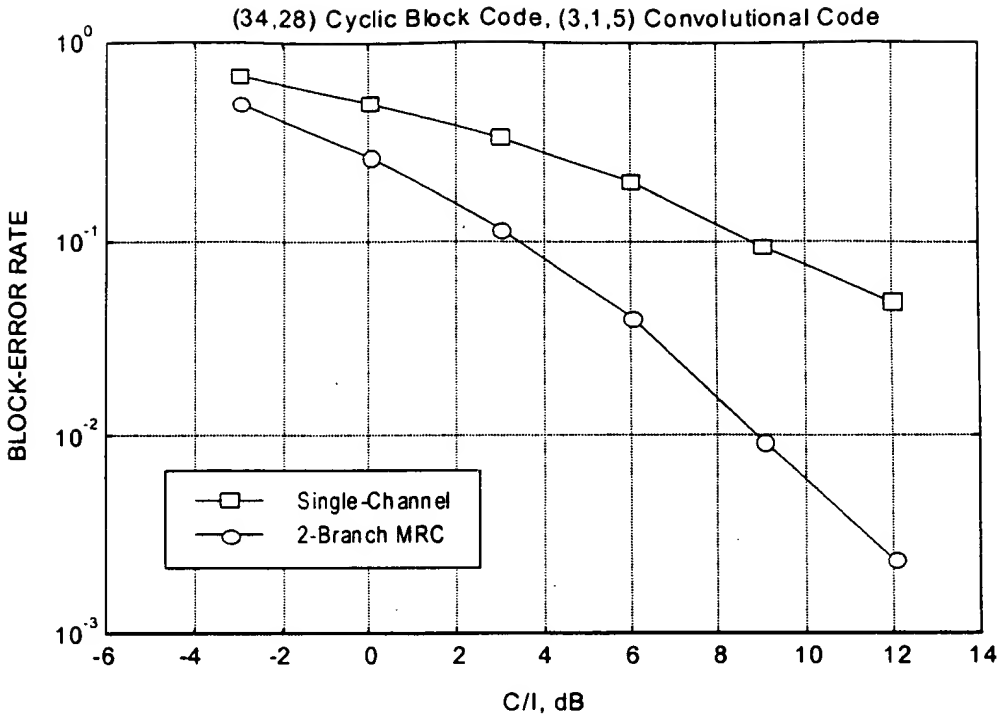

(34,28) Cyclic Block Code, (3,1,5) Convolutional Code
BLOCK-ERROR RATE
10^0
10^{-1}
10^{-2}
10^{-3}
-6
-4
-2
0
2
4
6
8
10
12
14
C/I, dB
Single-Channel
2-Branch MRC

FIG. 30

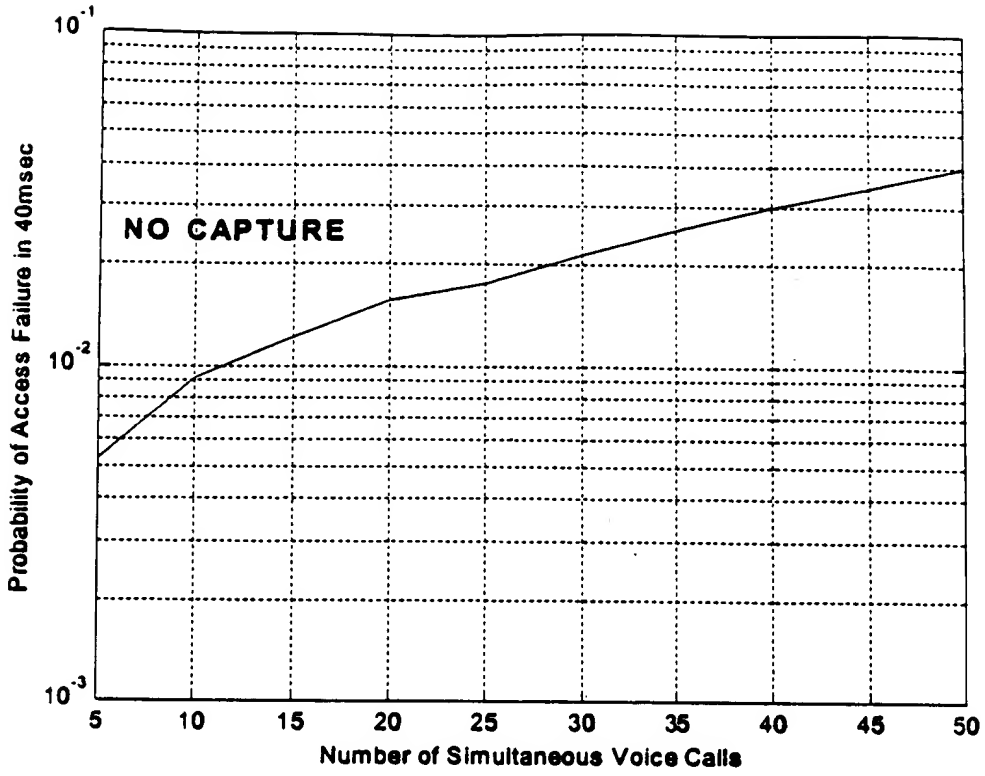

10^{-1}
10^{-2}
10^{-3}
Probability of Access Failure in 40msec
NO CAPTURE
5
10
15
20
25
30
35
40
45
50
Number of Simultaneous Voice Calls

FIG. 31

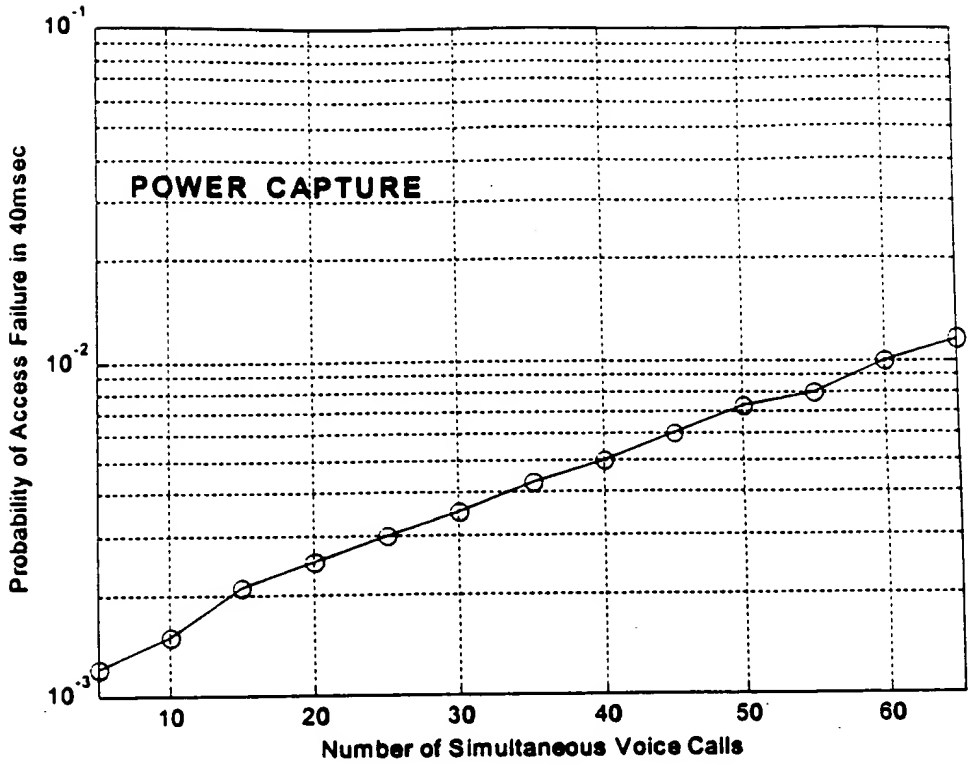

POWER CAPTURE
Probability of Access Failure in 40msec
10^{-1}
10^{-2}
10^{-3}
10
20
30
40
50
60
Number of Simultaneous Voice Calls

FIG. 32

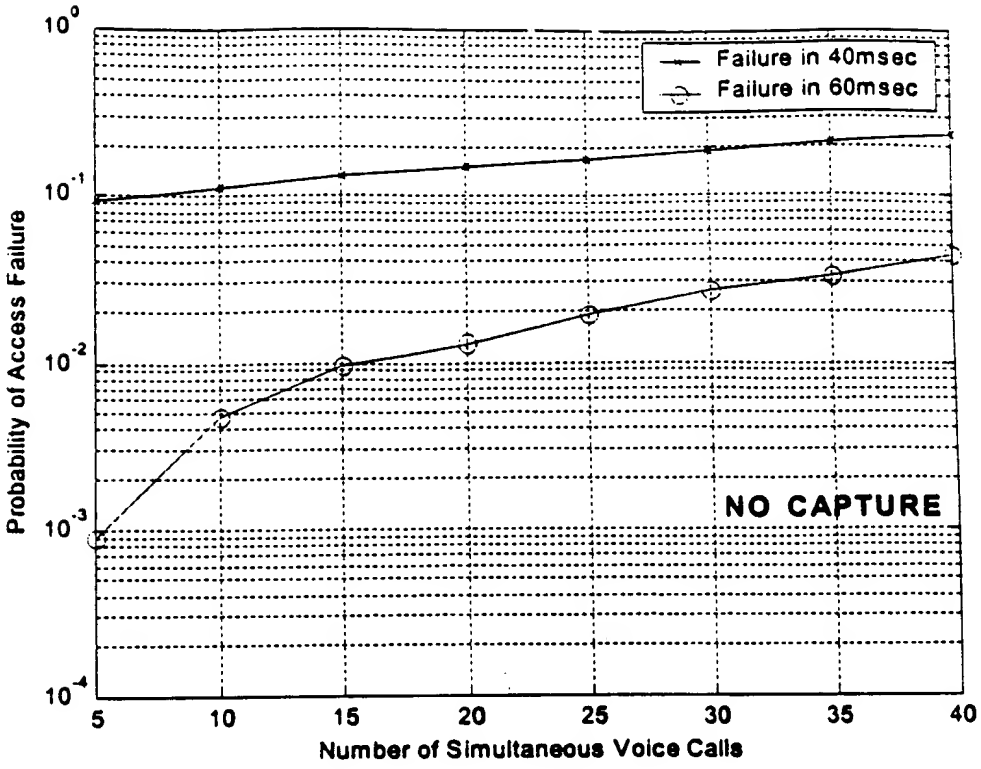

Failure in 40msec
Failure in 60msec
NO CAPTURE
Probability of Access Failure
Number of Simultaneous Voice Calls
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
5
10
15
20
25
30
35
40

FIG. 33

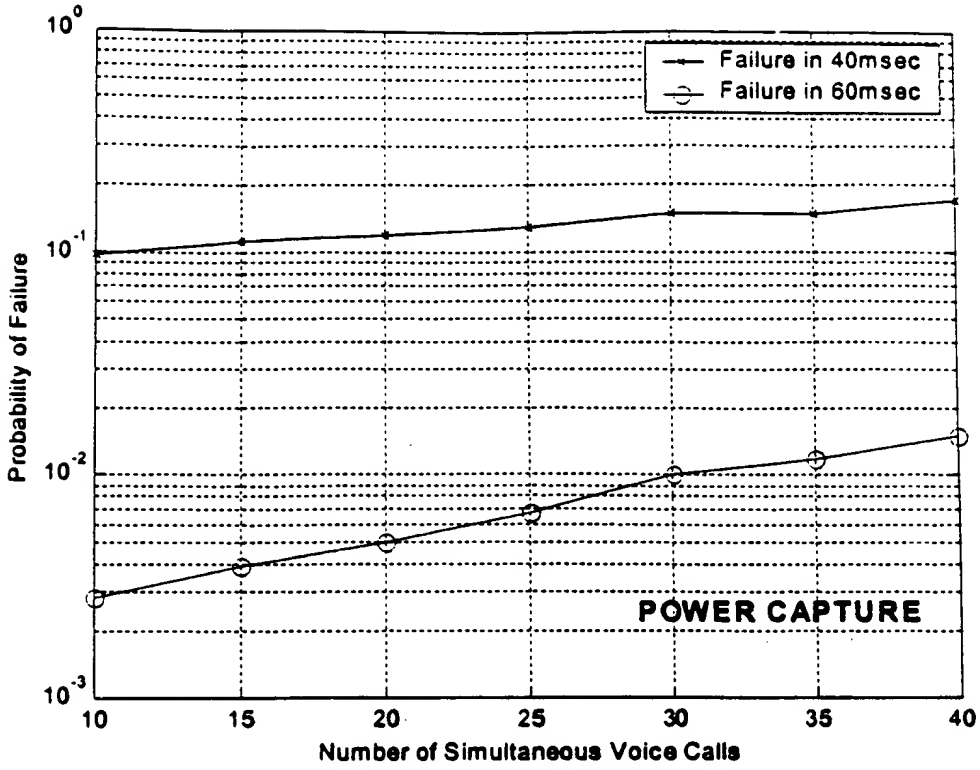

Failure in 40msec
Failure in 60msec
Probability of Failure
10^0
10^{-1}
10^{-2}
10^{-3}
POWER CAPTURE
10
15
20
25
30
35
40
Number of Simultaneous Voice Calls

FIG. 34

Number of Carriers (Slots)	Number of Uplink Control Slots	Number of Downlink Control Slots
3 (24)	3.6	2.4
4 (32)	4.8	3.2
8 (64)	9.7	6.5
12 (96)	14.5	9.7

Table of Computation of Control Overhead slots for half rate speech channels, as a function of number of carriers (n) in the deployment.

FIG. 35

Number of carriers	Number of simultaneous circuit voice calls	Statistical Multiplexing		
		Number of time slots available for multiplexing voice	Number of simultaneous voice calls	Drop Rate
3	24	18	27	9.6×10^{-3}
4	32	24	37	1×10^{-2}
8	64	48	76	8.7×10^{-3}
12	96	72	120	8.9×10^{-3}

Table of Statistical Multiplexing Capacity for Full Rate Speech

FIG. 36

Number of carriers	Number of simultaneous circuit voice calls	Statistical Multiplexing		
		Number of time slots available for multiplexing voice	Number of simultaneous voice calls	Drop Rate
3	48	36	60	1.07×10^{-2}
4	64	48	76	8.7×10^{-3}
8	128	96	160	8.4×10^{-3}
12	192	144	280	4.16×10^{-3}

Table of Statistical Multiplexing Capacity for Half Rate Speech

FIG. 37